ANCIENT CAPITALS FROM THE SOANE MUSEUM.

Fig. 1.

Fig. 2.

GEOMETRY OF ARCHITECTURE.

An inference from the third proposition of Euclid's elements of geometry supplies a most simple, ready, and useful method for drawing the radiating joints for the stones, &c., of large flat circular arches whose centres are inconvenient, and which are supposed to be inaccessible.

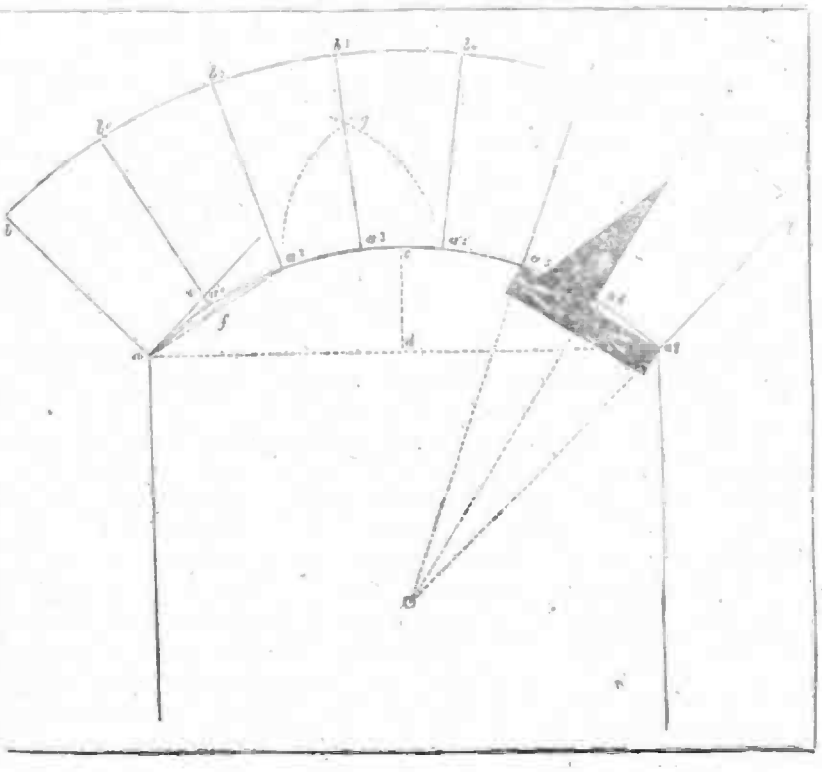
From points on the circumference of a circular arc, it is required to draw lines that shall be perpendicular to it at those points, and that shall pass through the centre of the circle; without reference to the centre, or making use of any constructive lines for the purpose.

Let $a\,c\,a_7$, be a circular arc; $a\,a_7$, the chord of that arc, or the opening; and $d\,c$, the versed sine, or rise of the arch; let a, a_1, a_2, a_3, a_4, a_5, a_6, and a_7, be the points for the joints of a series of arch stones. To draw the joint $a_6\,b_6$: apply a parallel ruler, or straight edge, on the next adjacent points from a_6 (that is, on the chord $a_5\,a_7$), slide a set square against the edge of the ruler until the right-angled edge of the set square coincide with the point a_6, and draw the joint $a_6\,b_6$, which will be perpendicular to the arc at the point of contact a_6, and also to the chord at the point i; and it will also radiate to the centre of the arc. Find the centre o, which may be easily effected by producing the lines $b_6\,a_6$, $b_7\,a_7$, till they meet in o, which is the centre of the arc. Produce $b_6\,a_6$ to o; and since the arc $a_5\,a_7$ is bisected in a_6, and the chord $a_5\,a_7$ in i, $a_6\,a_5 = a_6\,a_7$, and $i\,a_5 = i\,a_7$, and $o\,i$ is common to the two triangles $a_5\,i\,o$, $a_7\,i\,o$; and $a_5\,o = a_7\,o$; therefore the angle $a_5\,i\,o$ = the angle $a_7\,i\,o$ (*see Euclid* 8 *of* 1); consequently, whenever the chord of an arc, or the arc itself, is bisected by a perpendicular, it will radiate to and pass through the centre of the circle. The joints $a_5\,b_5$, $a_4\,b_4$, $a_3\,b_3$, $a_2\,b_2$, and $a_1\,b_1$ may be drawn by the same process, by applying the ruler successively on the next adjacent points as before.

Now, in order to draw the skew-back joints $a\,b$, $a_7\,b_7$, it will be necessary to find tangents to the arc at the points a a_7. From the point a set off $a\,a_1$, $a_1\,a_2$, at any equal distances on the arc, and join $a\,a_2$, $a\,a_1$, $a_1\,a_2$. Then with a as a centre, and radius $a\,a_2$, describe the arc $f\,e$; make $a_1\,e = a_1\,f$, and draw $a\,e$. Then, since inscribed angles, subtended by equal arcs, are equal to one another, therefore the angle $a_1\,a\,a_2$ = the angle $a_1\,a_2\,a$; and the angle $a_1\,a\,e$ = the angle $a_1\,a\,f$, or to the angle $a_1\,a_2\,f$; therefore, $a\,e$ is a tangent at the point of contact a. From the point a draw the skew-back joint $a\,b$ at right angles to $a\,e$; and proceed in the same manner for the skew-back joint $a_7\,b_7$. This problem of drawing a tangent to an arc whose centre is inaccessible, was first proposed and solved in the *Ladies' Diary*.

The applicability of this mode of finding the skew-back joints of circular arches is of manifest utility to plasterers and bricklayers, but more particularly to the latter, when forming the skew-backs of discharging and *counter* arches (*i. e.* arches over lintels, &c.); and were this method adopted and practised, it would prevent unsightly and weak arches from being formed, which too often is the case from a want of understanding the nature of their thrusts and pressures; for the joints of all arches should be perpendicular to the curve of the neutral axis which passes somewhere within the substance of the arch; but if the forces acting against the arch be very great, and the equilibrated curve corresponding to the pressure runs above the extrados or below the intrados, the material of the arch will yield, and very probably it may be thrown down. In reference to the skew-backs in question, it is desirable that their faces should be in the direction of the centre of the arc, in order to distribute and equalize the pressures, and to produce the greatest amount of strength. The true radiation of the skew-back may be obtained mechanically by simply setting off from the point a, on the *core* or centre, any two equal distances $a\,a_1$, $a_1\,a_2$; apply a line or plumb-rule from a to a_2, measure the distance under a_1 to the line, and set that distance above a_1 to e; then apply the line from a to e, and cut the skew-back $a\,b$ square from this line.

But the method of drawing the joints for the stonework of large flat circular arches for bridges, &c.,—and indeed its application in



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